Interface Definition Document (IDD)
& Payload Accommodations Handbook
for the
Deep Space Test Bed (DSTB) Facility
January 20, 2005

Mark Christl 1-20-2005

Mark Christl
Project Lead

Martha Milton 1-20-2005

Martha Milton
Project Manager

Table of Contents

Acronym List

1.0 Introduction
- 1.1 Purpose
- 1.2 Science Objectives
- 1.3 Background

2.0 Reference Documents

3.0 Deep Space Test Bed Facility Description
- 3.1 Mechanical System
- 3.2 Flight Computer and Data System
- 3.3 Power System
- 3.4 Thermal System

4.0 Experiment Selection Process and Schedule
- 4.1 Selection Process
- 4.2 Schedule
- 4.3 DSTB Funding

5.0 Experiment to DSTB Facility Interfaces
- 5.1 Exposure Deck
  - 5.1.1 Mechanical Interface
  - 5.1.2 Power Interface
  - 5.1.3 Flight Computer and Data System Interface
  - 5.1.4 Thermal Interface
- 5.2 Electronics Deck
  - 5.2.1
  - 5.2.2 Mechanical Interface
  - 5.2.3 Power Interface
  - 5.2.4 Flight Computer and Data System Interface
  - 5.2.5 Thermal Interface
- 5.3 Carousel
  - 5.3.1 Mechanical Interface
  - 5.3.2 Power Interface
  - 5.3.3 Flight Computer and Data System Interface

5.3.4 Thermal Interface
5.4 Boom
5.4.1 Mechanical Interface
5.4.2 Power Interface
5.4.3 Flight Computer and Data System Interface
5.4.4 Thermal Interface

6.0 Instrument Requirements
6.1 Power Requirements
6.2 Thermal Requirements
6.3 Flight Computer and Data System Requirements
6.4 Mechanical Requirements
6.5 General Requirements

7.0 Field and Ground Operations

Appendix:

i. DSTB Investigation Flight Application Form

Acronym List

A	Amps
AC	Alternating Current
AL	Alabama
atm	atmosphere
C	Celsius
CONUS	Continental United States
Deg	Degree
DC	Direct Current
DSTB	Deep Space Test Bed
FCDS	Flight Computer and Data System
FRR	Flight Readiness Review
g	Gravitational Force
GCR	Galactic Cosmic Ray
GPS	Global Positioning System
GSE	Ground Support Equipment
ICD	Interface Control Document
ID	Identification
IDD	Interface Definition Document
I/O	Input / Output
lbs	Pounds
LDB	Long Duration Balloon
LEO	Low Earth Orbit
mb	millibars
MHz	Mega Hertz
NASA	National Aeronautics and Space Administration
NRA	NASA Research Agreement
NSBF	National Scientific Balloon Facility
NSSTC	National Space Science and Technology Center
PC	Personal Computer
POC	Point of Contact
ps	pico seconds
SDC	Smart Data Connector
SIP	Standard Instrumentation Package
SRSP	Space Radiation Shielding Program
TBD	To Be Determined
TX	Texas
V	Voltage
VDC	Voltage Direct Current
W	Watts

1.0 Introduction

1.1 Purpose
The purpose of this document is to provide a “handbook” for investigators interested in using the Deep Space Test Bed (DSTB) Facility. The information will provide an understanding of the interfaces, requirements and the environments that their instruments will encounter during assembly, ground testing, transportation, flight, landing and post flight transportation.

1.2 Science Objectives
The DSTB Facility provides a new capability for the National Aeronautics and Space Administration’s (NASA’s) Space Radiation Shielding Program (SRSP). The objective of the DSTB is to provide a platform to conduct radiation shielding investigations in an environment more similar to deep space than most Low Earth Orbit (LEO) orbits or is achievable at a particle accelerator. The DSTB provides a means to experimentally test radiation shielding effectiveness of various materials and to test the accuracy of radiation transport code predictions in the deep space cosmic ray environment more frequently and at a lower cost compared to space flight missions. New spectrometers, dosimeters and other techniques may be exercised and verified using the DSTB before space flight. The DSTB will be implemented through NASA’s National Scientific Balloon Facility (NSBF) which provides polar balloon flights that lift science payloads to high altitude (120,000 ft. (36.58km)) to escape much of the shielding effects of the Earth’s atmosphere and magnetosphere. Polar flights are conducted through NSBF in coordination with the United States Polar Program. The DSTB will be launched on a Long Duration Balloon (LDB) from McMurdo, Antarctica (77.86 degrees south latitude) for circumpolar flights, nominally 20 days, traveling to the west and typically bounded between 73 to 82 degrees south latitude. Float altitudes for these balloons with payload are 115,000 to 130,000 feet (35.05 to 39.62km). The DSTB will be able to accommodate up to 20 investigations per flight. Annual flight opportunities are planned starting in December 2005. Balloon campaigns in Antarctica occur in December and January during the Austral summer.

Since a key goal of the DSTB facility is to efficiently serve the varied needs of the radiation shielding community, it must be designed with a flexible architecture. By implementing the DSTB facility with NASA's balloon program, which operates under reduced formalities compared to space flight, the DSTB facility can adjust for different investigation priorities on successive flights. This flexibility in the DSTB will be applied at several levels: in the distribution of the shared resources for each flight; addressing the payload configuration on a system level for each flight; and utilizing a selection process for investigations that considers yearly flight opportunities as well as the possibility for repeated flights. This approach for operating the DSTB facility will allow it to handle a wide range of investigations.

1.3 Background

The recommendation to develop the DSTB was arrived at by members of the Space Radiation Shielding community at the Berkeley Workshop (2000). The workshop report is available on the Space Radiation Shielding Program (SRSP) website. The decision to undertake a broad and systematic approach for investigations related to space radiation shielding issues by using the actual Galactic Cosmic Ray (GCR) flux was seen as a logical step that complemented the past and present studies using accelerator based ground measurements.

The DSTB will be implemented with NASA's Sub-orbital Program that is managed by the Wallops Flight Facility and operated by NSBF at Palestine, Texas. This program has provided scientific investigations for more than 40 years with campaigns worldwide. The NSBF has averaged more than 20 flights per year that included two Antarctic circumpolar flights per year for the past 15 years. The NSBF provides flight operation support and organizes the field campaigns.

The DSTB is one element of the SRSP managed by NASA/Marshall Space Flight Center (MSFC). The DSTB project is operated from the National Space Science and Technology Center (NSSTC) in Huntsville AL. The NSSTC has dedicated facilities for development, integration and testing of balloon borne instruments.

2.0 Reference documents

NSBF Recommendations for Gondola Design
Small Explorer Class Library, Long Duration Balloon Opportunities
National Scientific Balloon Facility, Long Duration Balloon Flight FY'04
Application Form and Enclosures
Space Radiation Shielding Workshop Report (Berkeley, CA, 2000)
XD50 Safety Plan for General Work
NSBF Ground Safety Plan

3.0 Deep Space Test Bed Facility Description

The DSTB Facility has four major subsystems: Mechanical, Flight Computer and Data System (FCDS), Power, and Thermal. A brief description of each of these is given in the following Sections.

3.1 Mechanical System

The DSTB Facility Mechanical System is a self-contained gondola, which houses the investigators instruments, data and command electronics and the power system. The Facility contains 5 functional levels (Figure 1). Starting at the top they are: the exposure deck, the electronics deck, the Balloon Support Instrument Package (SIP), the SIP solar panels and the DSTB solar panels. The SIP and SIP solar panels are provided by NSBF.

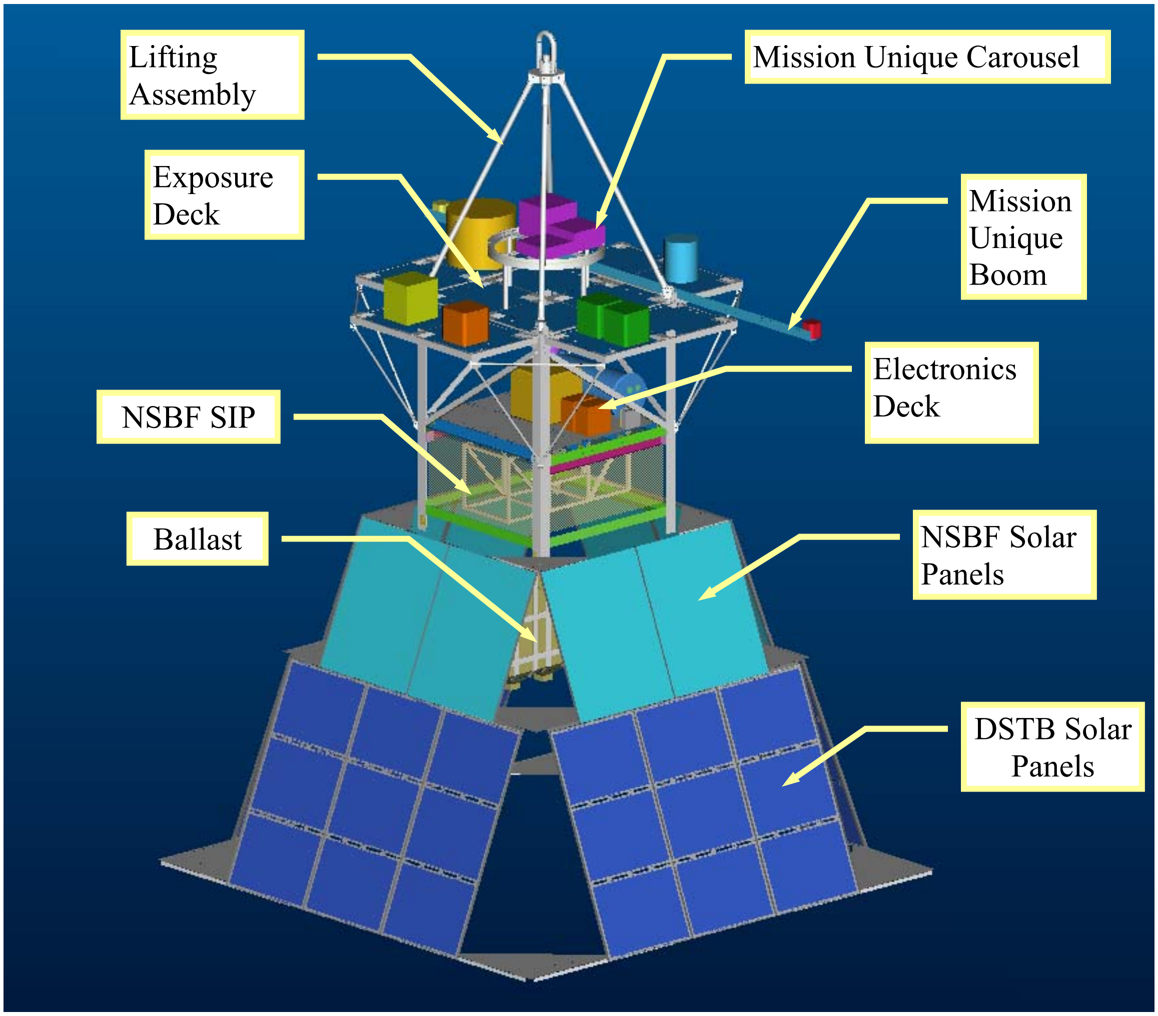

Figure 1: DSTB Configuration

The exposure deck will house most of the investigators instruments for each mission. This deck can be reconfigured to meet the requirements of a particular mission; however, it will have a basic structure consisting of replaceable panels. The design has 12 separate panels approximately 25.8″× 25.8″ (65.53cm x 65.53cm), each a mounting platform for investigators. The panels fit within the perimeter of the upper deck. Additional space is available on the electronics deck for investigators electronics. The exposure deck is also capable of holding a carousel of shielding materials. Detectors will be placed below the carousel to measure the transmitted radiation. In special cases small instruments may be placed on booms extending from the gondola, away from the central mass of the DSTB.

The electronics deck is located directly beneath the exposure deck. This platform houses the Flight Computer and Data System (FCDS) electronics and all of the major Power System components except for the solar panels. This reduces the mass on the exposure deck that can influence the radiation environment for the experiments. There will be space available on the electronics deck for investigator’s instruments and/or electronics that do not require direct exposure.

The NSBF SIP is located directly below the electronics deck. Although the SIP itself is provided by NSBF, the structure for mounting the SIP is being provided by the DSTB Facility.

The solar panels for the SIP and DSTB are located below the SIP at the bottom of the gondola. The SIP solar panels will be provided by NSBF. The DSTB solar panels, in conjunction with the DSTB batteries, supply power to all of the DSTB electronics and the investigators' instruments.

The ballast, supplied by the NSBF, will be suspended from the 4 main support angles below the SIP.

Further information concerning experiment interfaces is in Section 5.2.1.

3.2 Flight Computer and Data System

The FCDS is an electronic data acquisition and control system whose primary functions are:

1. To provide the communications and control interface between the DSTB Facility investigator instruments and the NSBF SIP. The SIP in turn provides links to the ground, allowing data to be sent from the experiments to the ground and commands to be sent from the ground to the experiments.
2. To provide on-board storage of experiment data.
3. To measure and report the state of the experiments and the DSTB Facility status (temperatures, pressures, currents, etc.).
4. To provide GPS location and time as requested by experiments.
5. To operate the DSTB Facility autonomously if communication with the ground is lost.
6. To control power to the experiments.

The FCDS consists of two components: a PC104 computer and the Smart Data Connector (SDC). The PC104, physically located on the electronics deck, will use mostly commercial off-the-shelf equipment and will be configured similarly from flight to flight. One SDC will be physically located on or near each instrument's panel and will provide a RS232/RS422 data interface to each instrument. In addition the SDC can monitor temperatures in the immediate experiment environment and provides some current switching capability.

Further information on the FCDS and instrument interface is in Section 5.
Further information on the SDC is in Section 5.

3.3 Power System.

The DSTB Facility power system provides power to the electronics deck and the investigator's instruments. It consists of solar arrays, batteries, a regulator/battery charging system, remote resettable circuit breakers, and DC-DC converters. The remotely operated circuit breakers provide on/off power switching and current overload protection to the experiments. The power system can provide up to 600 watts (to be divided among experimenters) at 28±6 VDC.

Further information on the Power interface to instruments is in Section 5.2.2.

3.4 Thermal System.

The DSTB Facility thermal system must ensure that all equipment on board will not be subjected to temperature or thermal stresses beyond their operating limits. It is anticipated that the required thermal environment can be achieved through the use of passive methods, e.g. thermal coatings and insulation. Thermal analysis will be used to determine the configuration of the thermal system. The DSTB organization will be responsible for the thermal modeling of the integrated DSTB Facility while each principal investigator will provide the thermal parameters of his individual instrument.

Further information on the Thermal system interface is in Section 5.2.4.

4.0 Experiment Selection Process and Schedule

4.1 Selection Process

The DSTB Facility Operation will begin with the selection of payloads for each flight. Applications for the payload slots will be taken from the scientific community. Investigators interested in utilizing the DSTB Facility for radiation shielding studies should submit an Application (Appendix i.) to the DSTB Facility Point of Contact (POC) listed in at the bottom of the application. This application solicits general information and requirements from the investigator necessary to evaluate the compatibility of the instrument and relevance of the investigation to the SRSP goals. These applications will fall in to one of the following four categories:

1) Research experiments that have been previously selected competitively and are currently supported by the Space Radiation Shielding Project.

2) Research experiments that are not supported by the SRSP, but are supported by other project within the Radiation Program Element. These Applications should include a letter of endorsement from the Project Scientist and the Project Manager of the sponsoring Project.

3) Peer reviewed research experiments supported by NASA, but not by projects within the Radiation Program Element. These Applications should include a letter of endorsement from the Sponsoring Organization, as well as from the Project Scientist and the Project Manager.

4) Research experiments from outside the NASA community. Prior to being considered the application will be peer reviewed to determine their value to the NASA community.

The applications will then be evaluated by the DSTB Project Team for compatibility with the DSTB Facility and the compliment of payloads already chosen for the flight. Note: If the recourses to evaluate a payload are beyond the recourses of the DSTB Project, the

Project may ask the payload to contribute recourses to complete the evaluation. The Application will then be sent with the teams recommendations to the Space Radiation Shielding Project. For an Application in category 1 or 2 the selection will be made at the SRSP level. For an Application in category 3 and 4 the selection will be made at the SRSP level but concurrence from the Radiation Health Program Manager is required.

4.2 Schedule

Following the publication of the selection of the investigations for the Antarctic Balloon Flight manifest, the chosen investigators will begin working with the DSTB Facility management and engineering team to develop a mechanical, electrical and data Interface Control Document. This document will define the specific interfaces and requirements the experiment will be expected to comply with for integration on the DSTB. Interfaces that are deemed critical by the DSTB Team will be verified by test or analysis. The ICD will be completed and signed off 15 months prior to the Antarctic flight. The next milestone for the investigators is to supply their thermal inputs to the DSTB Facility thermal model. This input will be due 13 months prior to the flight.

Investigators will use the ICD to complete the development and testing of their instruments. Participation in the DSTB Experiment Mission Review 11 months prior to flight will be required. After completion of the review, the investigators will implement any changes agreed to at the review. The instruments will be delivered to the DSTB facility in Huntsville, AL 9 months prior to flight for integration and testing. At the successful completion of the integrated payload (gondola) testing in Huntsville the DSTB field team will assume responsibility for further operations of the investigation instruments. (Further operations of individual instruments may require close cooperation with the investigators including data transmitted to their facilities). The DSTB facility will then be disassembled 7 months prior to flight and transported to Palestine, TX for integration of the SIP and complete payload testing. A Mission Readiness Review will be conducted in Palestine, TX 4 months prior to the Antarctic Flight. Immediately following the MRR the DSTB facility and experiments will be disassembled and shipped to Antarctica. The shipment is expected to arrive at McMurdo Station approximately 2 months prior the Flight. The DSTB team will arrive to reassemble and check out the Facility approximately 1 month prior to flight. Antarctic Balloon flight launch opportunity is from the first to the last of December with the flight lasting into January.
See the following schedule Table 1 for a better understanding of the time line.

ID	Task Name
1	Experiment Applications Submitted
2	Experiments Selection
3	Experiment ICD Developed
4	Experiment Thermal Inputs Due
5	Experiment Mission Review.
6	Experiment Fabrication and test
7	Experiment/DSTB Integration and Test
8	DSTB Disassembled and shipped to Palestine
9	DSTB Reassembled and SIP integration
10	Mission Readiness Review
11	DSTB Dissassembled & Shipped to Antarctica, Reassembled for Flight
12	DSTB Antarctic Flight
13	DSTB Recovery and Shipment back to NSSTC

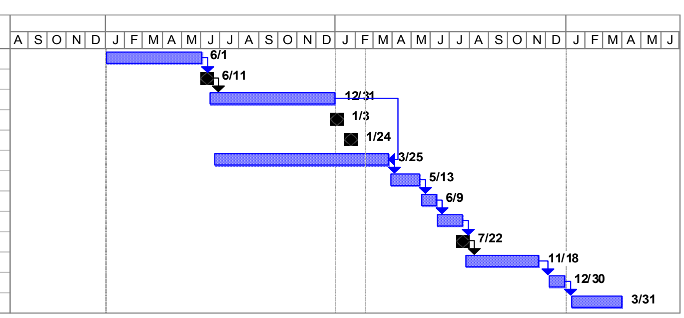

Table 1: Experiment Schedule

Following the balloon flight from McMurdo and recovery of the DSTB, the gondola will be recovered, disassembled and returned to the NSSTC DSTB manufacturing site in Huntsville, AL. Return of instruments to their owners will be approximately 3 months following the flight, but will depend on a number of factors. Investigators should be aware that occasionally the DSTB with its instruments may be lost, destroyed or unrecoverable.

LEGAL disclaimer
It should be noted that owing to the nature of balloon flights and the remoteness of most flight paths there is no guarantee that a payload will be recovered. Nor is there any guarantee that recovery will include all equipment or data. The recovery of equipment will be at the discretion of NSBF, DSTB, NASA and the Federal government as well as other entities not specifically listed. **If you cannot afford to lose it, don't use it!**

4.3 DSTB Funding

The SRSP sponsors the DSTB Facility and its operations. This includes negotiating for the required balloon equipment and operations that are available at NSBF. The DSTB will carry a minimal set of radiation measurement instrumentation for each flight to characterize and monitor the primary GCR environment reaching the DSTB, and the background component due to the presence of the atmosphere and interactions in the gondola. The DSTB facility also provides instruments to measure the radiation shielding effectiveness of novel shielding materials. Instrumentation required, beyond the above mentioned, may be funded through proposals to NRA's or funding processes from other agencies. Additional instrumentation may become available from the DSTB under special circumstances.

Funding for individual investigations which may include tests of radiation shielding materials, measurements and comparison with radiation transport codes, and other radiation shielding investigations will be funded through proposals to NRA's or funding processes from other agencies. Other costs to the investigators will depend on the proposed experiment and may include: support during integration at NSSTC, NSBF Palestine and possibly field operations during the campaign. The DSTB POC can provide an assessment of the types and amount of support that the investigator will likely need to provide for a flight.

5.0 Experiment to DSTB Facility Interfaces

The following Sections describe in more detail the DSTB subsystems and give information concerning the interfaces to the investigation instruments accommodated on the Deep Space Test Bed Facility.

5.1 Exposure Deck

5.1.1 Mechanical Interface

The Exposure Deck (Figure 2) mechanical interface design consists of 12 separate panels each of which is a mounting platform for experiments. The panels fit within the perimeter of the upper deck, see Figure 2. The 4 interior panels and 8 exterior panels measure 25.8” x 25.8” x 0.25” (65.53cm x 65.53cm x .635cm) (Figure 3). This panel is provided by NSSTC. The Panel can be tailored by the individual experimenter as long as bolting and connector locations are followed per Figure 3 (Drawing DSTB-MECH-100). These panels are removable, allowing the investigator to take them to their home facility for integration. Each panel is designed to support up to 150 lbs (68.04 kg) of experiment weight and will have the hole and cut out configurations shown in Figure 3. The orientation of the holes and cut outs will depend on the placement of the panel on the exposure deck. Experimenters can mount their hardware on both sides of the plate (size and weight requirements are given in Section 6.4) following approval through the ICD process. The hardware can be attached to the panel by fasteners which meet the grounding and thermal requirements described in Section 6.

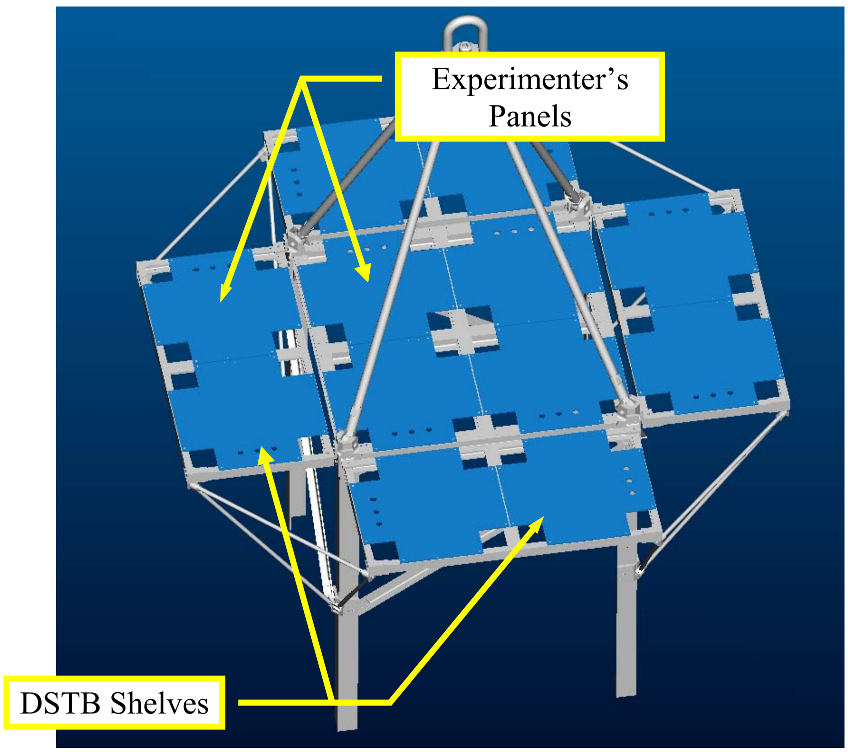

Figure 2: DSTB Facility Exposure Deck.

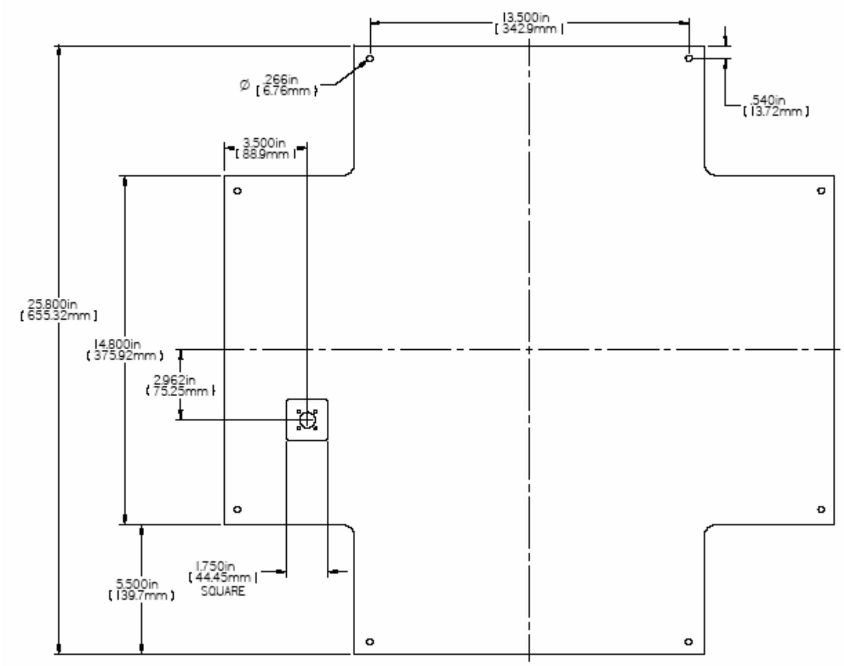

Figure 3: DSTB Exposure Deck Panels.

5.1.2 Power Interface

The DSTB Facility Power System consists of a set of solar panels connected in parallel, two 12V rechargeable sealed lead-acid batteries connected in series, a 24V regulation/battery charging system, two 28V DC-DC converters connected in parallel, and relays and circuit breakers for switching power on and off to the loads. This system will interface with the experiments through the power connectors listed below located on the experimenters mounting panel. The power provided during the flight will be 28±6 VDC and the Watts per instrument will be based on the total 600 watts divided among the number of instruments on the flight and will be determined on a case by case basis. The power the experimenter needs should be indicated on the application to start the discussions.

Power Receptacle Connector: P/N MS27656T11B5P
This Connector and pins will be supplied by DSTB. 5 Pins, 7.5 Amps per pin using 20 AWG wire. Contact size is 20, military part number M39029/58-363. Pins require crimp tool M2250/1-01 with turret M22520/1-02 available from Daniels Manufacturing Corp. Soldering a wire to the pin is an option given that no solder is allowed on the outside surfaces of the pin. Table 1 shows the pin assignments for the Power connector.

A	+28VDC
B	28V Return

C	Chassis Ground
D	Unassigned
E	Unassigned

Table 1: Power Connector Pin Assignments

5.1.3 Flight Computer and Data System Interface

The FCDS provides a total of 20 Gigabytes of onboard data storage during the LDB flight. This amount will be divided among the experiments (individual amounts will be determined after a flight's manifest is decided). In addition telemetry of data is available during the flight in one of two modes: Line of Sight (LOS) and continuous. LOS data is available while the payload is within approximately 100 nm of McMurdo. The maximum LOS data rate for the facility will be 700 kbit. This bandwidth must be shared among all experiments. When LOS is not available telemetry will be through TDRSS satellite relay. This bandwidth also must be shared among all experiments. For a fully loaded DSTB facility flight the average rate for any one experiment must be less than 30 bytes/sec. Consult with DSTB personnel for the particular flight average rate specification. Bursting of data is allowed as long as the average rate is kept within specifications.

The SDC provides the physical layer between the FCDS and an instrument. The instrument interface is provided through asynchronous serial ports that may be configured as RS232 or RS422. Baud rates of 2.4k to 115.2k are supported. The SDC will provide a Low Rate (LR) serial port for data to be transmitted through TDRSS to the GSE and a High Rate (HR) serial port for data to be transmitted through the LOS or stored in the 1 gigabyte of allotted onboard storage.

The SDC power consumption is approximately 3.5 watts. This power is considered part of the instruments overall power allocation. The investigator is responsible for providing power to the SDC from the power connector. SDCs will operate on the primary bus voltage of +28VDC. The SDC is housed in an aluminum enclosure as shown (Figure 4).

For more specific interface information see the SDC Specification and User's Manual which can be found on the DSTB website at:
http://sd.msfc.nasa.gov/cosmicray/DSTB/DSTB.htm

For information concerning electrical grounding see the 'Deep Space Test Bed Grounding Plan' which can be found on the DSTB website.

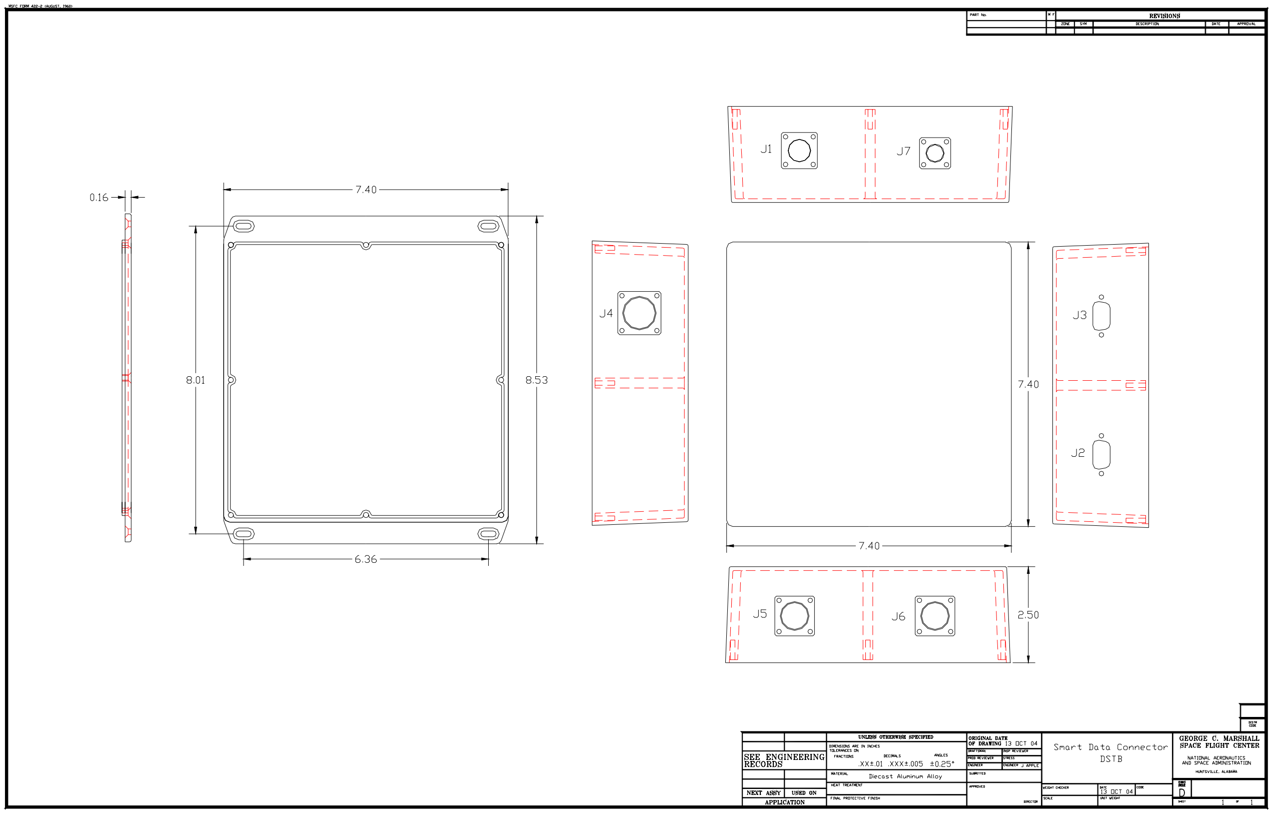

Figure 4: SmartPort Box.

5.1.4 Thermal Interface

The major sources contributing to the thermal environment of the DSTB balloon flight missions are (1)-direct solar radiation, (2)-reflected solar radiation from the Earth (albedo), and (3)-infrared radiation from the Earth. The nominal solar flux experienced during the Austral summer season is 1348 Watts/m^2 (1134 watts/yd^2) with the Earth's albedo being as high as 95% when the balloon trajectory encounters a fresh blanket of snow. At lower altitudes as the balloon ascends through the troposphere the ambient air temperature may reach -65°C (-85°F). However, when the float altitude is approached, convection becomes negligible due to the low ambient pressure. Temperature and Pressure Environments are given in Section 6.2.

In general thermal control of the DSTB will be via passive thermal absorption and radiation. Passive methods will be employed to control the instrument temperature within predefined limits and, if necessary, reduce the temperature gradient in critical areas of the payload. This requires specifying the insulation materials, the surface optical coatings and radiant heat exchange, and conduction paths to establish a temperature profile for each instrument over the course of a balloon flight. Some of the investigators may want to thermally isolate their instruments from the DSTB gondola. Some power may be available for heating and cooling to further control the temperature of individual instruments. Specifically, power dedicated to thermal control may be required during the pre-launch preparation, ascent and flight phases of the DSTB. Any active thermal protection needed during the flight will be negotiated with by the DSTB program and become a part of the instrument's power allotment as specified in the ICD.

5.2 Electronics Deck

The instruments and/or associated hardware mounted on this deck will be handled on a case by case basis.

5.2.1 Mechanical Interface

Instrument equipment located on the Electronics Deck will be attached by means that meet the Mechanical Requirements given in Section 6.

5.2.2 Power Interface

Equipment located on the Electronics Deck will utilize the connectors provided for the instruments on the exposure deck panel.

5.2.3 Flight Computer and Data System Interface

Equipment located on the Electronics Deck requiring communication with the FCDS will utilize the connectors provided for the instruments on the exposure deck panel.

5.2.4 Thermal Interface

Equipment located on the Electronics Deck will be treated with the same thermal interface requirements as instruments located on the Exposure Deck.

5.3 Carousel

The instruments or associated hardware mounted on the carousel will be handled on a case by case basis

5.3.1 Mechanical Interface

For specific flights the exposure deck is designed to hold a carousel of shielding materials near the middle of the exposure platform. DSTB program detectors and/or selected investigator instruments will be placed below the carousel to measure the transmitted radiation. During the flight a motor periodically rotates the carousel to move the shielding materials over the different detectors or instruments. The materials can be attached to the Carousel by means that meet the requirements in Section 6 of this document. The detectors or instruments to measure the shielding properties for the experiment material will occupy the remaining space available on the 4 panels below the Carousel. The mechanical interfaces for these devices will not be the same as those stated for the exposure deck See interior envelope specifications Section 6.4. A concept of the carousel and detectors/instruments is shown in Figure 5.

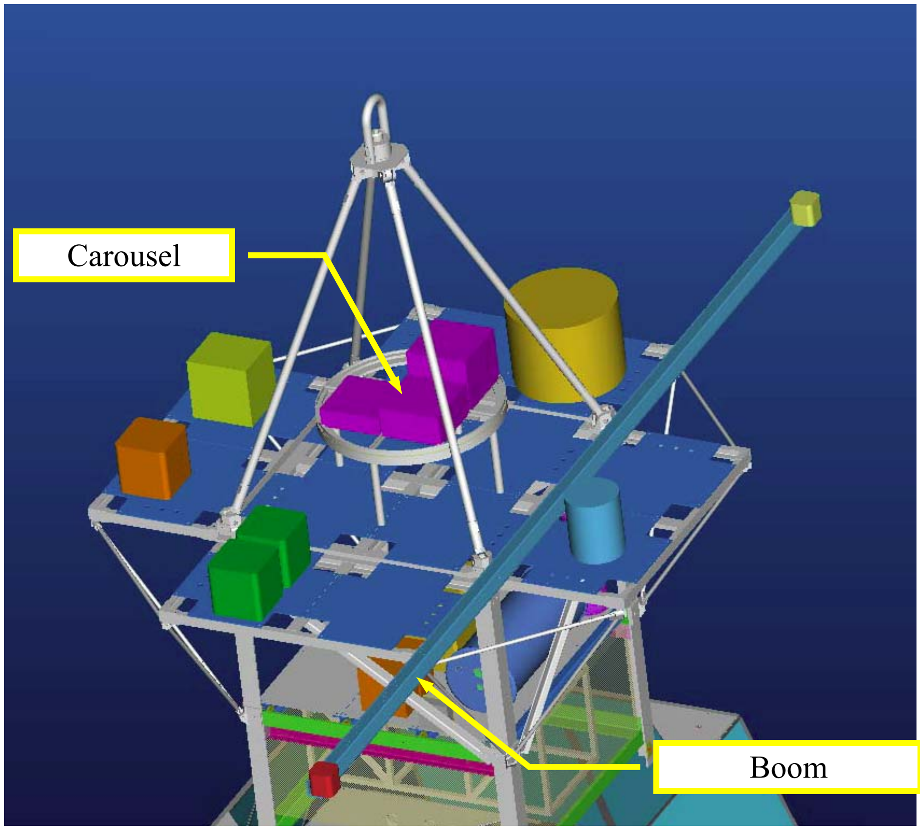

Figure 5: Mission Particular Carousel and Boom

5.3.2 Power Interface
There is no interface for power for the materials. The Power to run the Carousel will be shared by the investigators using it. Detectors or instruments located beneath the carousel requiring power will have the same interface as the other instruments on the exposure deck.

5.3.3 Flight Computer and Data System Interface
There is no interface to the FCDS for the materials on the Carousel. There will be FCDS interfaces for the detectors or instruments operating under the carousel and they will be the same as the interfaces described for the exposure deck. The carousel commanding and data retrieval operations will be agreed to by the materials investigators and instrument providers.

5.3.4 Thermal Interface
The thermal interfaces for the materials on the Carousel are dependent on the material's properties. The thermal interfaces for detectors or instruments below the carousel are the same as for the exposure deck. Any thermal control will be negotiated with the DSTB management through the ICD process.

5.4 Boom
The Boom is designed to hold a passive instrument as far away from the main structure of the DSTB gondola as practical.

5.4.1 Mechanical Interface
Instruments and Detectors located on the Boom will be mechanically attached by means that meet the requirements in Section 6.

5.4.2 Power Interface
Detectors or instruments located on the Boom requiring power will interface in a similar fashion as instruments on the exposure deck. Power will be delivered by cables directly from the DSTB power distribution enclosure.

5.4.3 Flight Computer and Data System Interface
Detectors or instruments located on the Boom requiring communication with the FCDS will interface by running cabling along the boom extension to a Smartport mounted on the Electronics Deck.

5.4.4 Thermal Interface
The thermal interface for instruments placed on the boom is the same as for the exposure deck. Any thermal control will be negotiated with the DSTB management through the ICD process.

6.0 Instrument Requirements

6.1 Power Requirements
The power subsystem for the DSTB provides power to the DSTB FCDS, the DSTB standard radiation monitors and the investigators' instruments. The SIP that contains the balloon flight control equipment obtains power from its own separate solar panels.

6.1.1. The instruments aboard DSTB shall operate on the shared 600 watts of power received from the power system for the duration of the balloon flight (maximum of 30 days). Actual watts per instrument shall be determined on a case by case basis.

6.1.2. The instruments shall operate on the provided unconditioned 28 ±6 VDC.

6.1.3. The instruments shall use quick disconnect connectors provided by the DSTB for power delivered by the DSTB.

6.1.4. The instruments shall have critical hardware identified and labeled for recovery purposes.

6.1.5. The instruments shall be prepared at integration to comply with DSTB recommendations to reduce noise (spikes, transitions) back in to the Power Subsystem.

6.1.6 The instruments shall be connected to the power system through commandable circuit breakers provided by the DSTB project.

6.2 Thermal Requirements

Thermal requirements are derived from the Antarctic environments during launch, ascent, and at altitude. The FCDS will be turned on and running during the launch operations and ascent. The environmental extremes occur during ascent (cold (-75°C/ -103°F); convective, conduction) and at altitude (hot (75°C/ 167°F), radiant, conductive). It is the goal of the DSTB to maintain the thermal operating temperature of the instruments by passive means.

6.2.1. The instruments shall withstand thermal operating temperatures between 0°and 50° C (32° and 112° F).

6.2.2. The instruments shall withstand Pressures between 0.987 and 0.00296 atm. (1000 and 3 millibars).

6.2.3. The instruments shall supply the DSTB with thermal model inputs.

6.3 Flight Computer and Data System Requirements

6.3.1. The instruments shall transfer data and communicate to the FCDS through provided connections.

6.3.2. The instruments shall receive commands through the FCDS from the ground station through the command link in a serial stream of the experimenters choosing.

6.3.3. The instruments shall send science data to the FCDS in a serial stream of the experimenters choosing.

6.3.4. The instruments shall have an average per experimenter of 1 Gigabyte of storage space for data on the FCDS.

6.3.5. The instruments aboard the DSTB shall interface with the FCDS to share downlink capabilities.

6.4 Mechanical Requirements

6.4.1. The instruments on the exposure deck shall interface with the provided removable mounting plates.

6.4.2. The instruments located on the electronics deck shall be handled on a case by case basis and the requirements for an individual's instruments shall be given in that instruments' ICD.

6.4.3. The instruments shall withstand a side acceleration of 5 g and 10 g acceleration down.

6.4.4. The instrument shall be constructed of materials that do not depart from tensile strength used in load calculations or have thermal expansion sufficient to overstress fasteners etc.

6.4.5. The total instrument weight on an exposure deck panel shall not exceed 150 lbs (68.04kg), not including the 14.5 lb (6.58kg) panel.

6.4.6. The instruments located on the interior panels shall be within the volume shown in Figure 6.

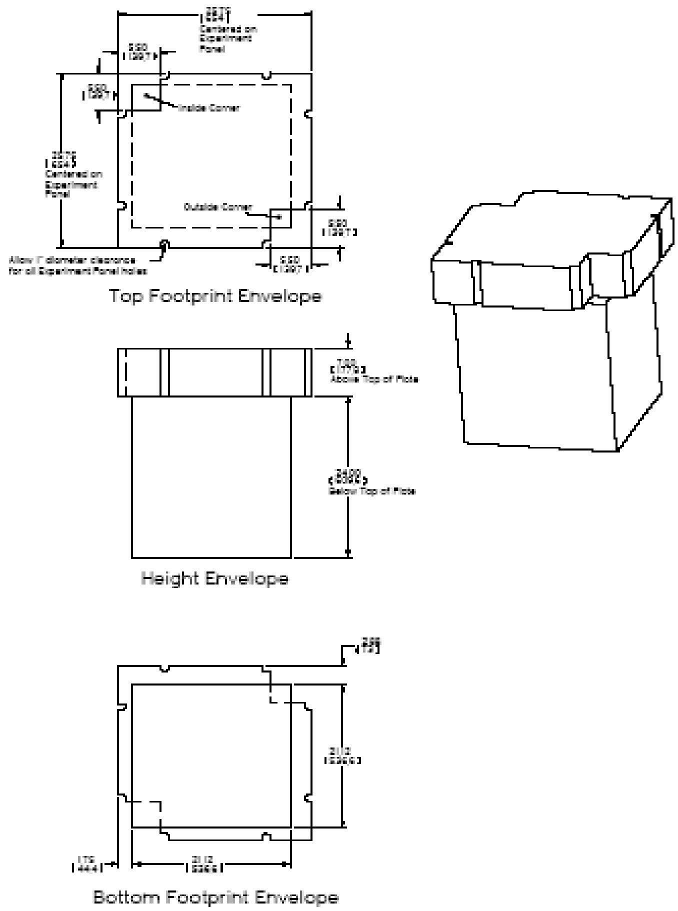

Figure 6: Interior Panel Volume

6.4.7. The instruments located on the outside panels shall fit within the volume shown in Figure 7.

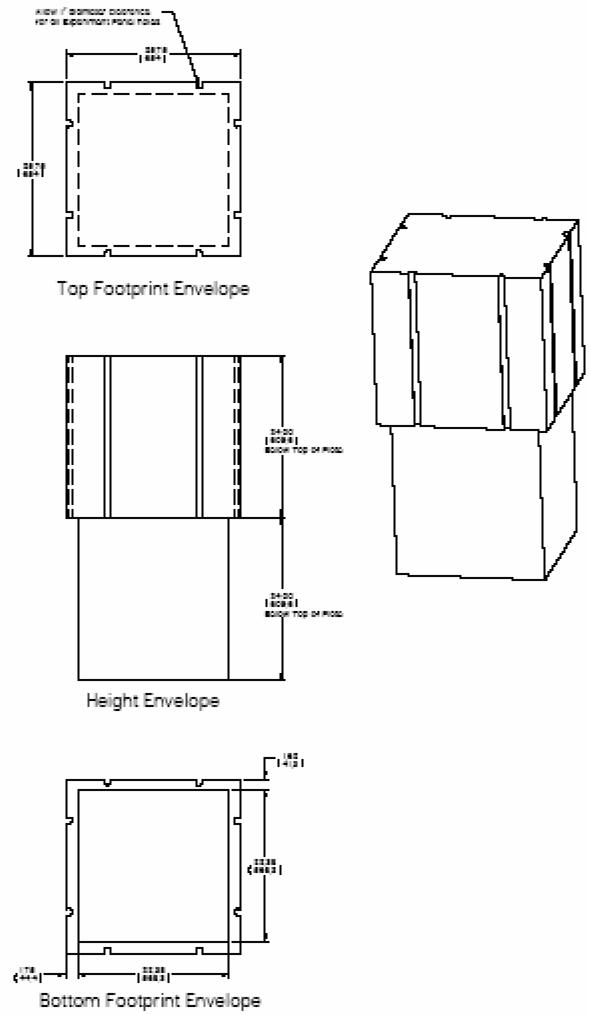

Figure 7: Exterior Panel Volume

6.4.8. The weight of the materials on the Carousel shall not exceed 45 lbs (20.4 kg) total. This weight will be divided among the materials selected for the flight.

6.4.9. The materials located on the Carousel shall use the attach points shown in Figure 8 and not exceed 8" (20.32cm) in Height. A total of 5 attach points are available. The holes are located on flanges which are 0.15 inch (0.38 cm) thick aluminum. Each attach point is a 0.25 inch (0.64cm) diameter hole. Any fastener used should not stick more than 0.2 inches below the carousel Table surface. (This will allow placement of materials within 0.2 inches (0.51 cm) of the detectors). While these five attach points are available, it is recommended that the weight be distributed along the lip for each section. This is recommended for test materials (irradiated material) that are at the upper limit of the allowable weight (45 lbs/20.4 kg).

6.4.10. Instruments located below the Carousel shall fit into one of the four panels beneath the Carousel with the volume shown in Figure 9.

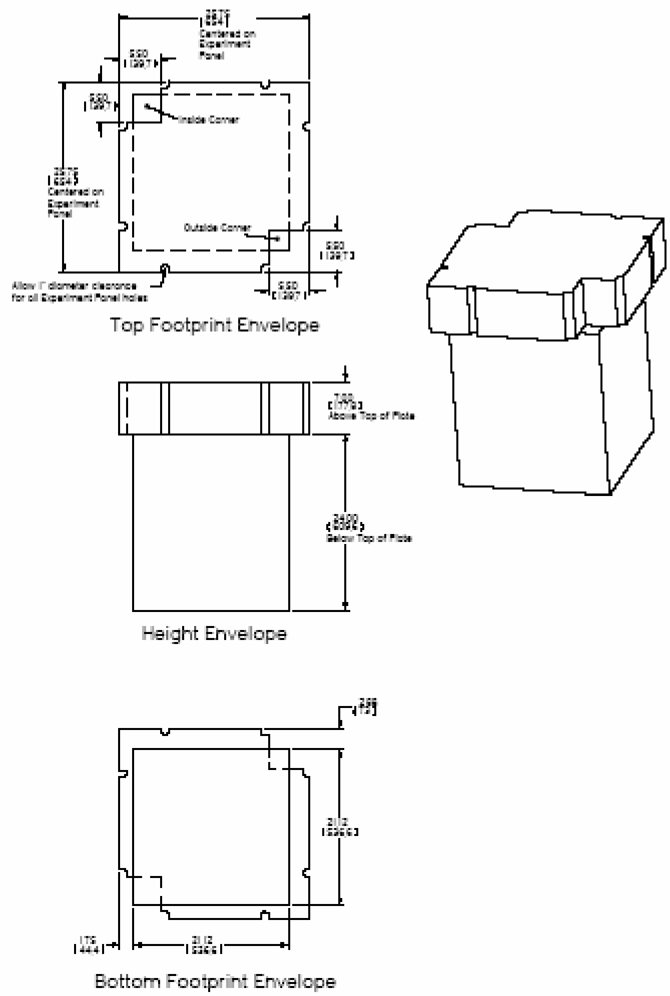

Figure 9: Below Carousel Panel Volume

6.4.11. The Boom instruments weight and CG shall fall within the parameters listed in Table 2.

Angle Size (in inches)	Boom Length = **4 feet** (from Corner Post) Maximum Experiment Weight (lb)	Weight of Boom (lb)	Boom Length = **6 feet** (from Corner Post) Maximum Experiment Weight (lb)	Weight of Boom (lb)	Boom Length = **8 feet** (from Corner Post) Maximum Experiment Weight (lb)	Weight of Boom (lb)	Boom Length = **10 feet** (from Corner Post) Maximum Experiment Weight (lb)	Weight of Boom (lb)
2 x 2 x .125	5.35	3.59	4.33	4.75	3.15	5.92		
2 x 2 x .188	7.54	5.31	6.01	7.03	4.24	8.75	2.42	10.48
2.5 x 2.5 x .188	14.08	6.70	11.20	8.88	8.24	11.05	5.46	13.22
3 x 3 x .188	23.04	8.10	18.20	10.72	13.63	13.35	9.60	15.97
3 x 3 x .25	29.26	10.65	22.92	14.10	16.98	17.56	11.77	21.01
3.5 x 3.5 x .25	44.05	12.50	34.27	16.56	25.70	20.61	18.52	24.67
4 x 4 x .25	62.20	14.35	48.05	19.01	36.26	23.66	26.74	28.32
4 x 4 x .375	86.72	21.18	66.32	28.05	49.49	34.92	35.96	41.80

* Center of Gravity of experiment must be kept within 5" of angle corner horizontallly and vertically

Angle Size (in inches)	Boom Length = **1.22 m** Maximum Experiment Weight (kg)	Weight of Boom (kg)	Boom Length = **1.83 m** Maximum Experiment Weight (kg)	Weight of Boom (kg)	Boom Length = **2.44 m** Maximum Experiment Weight (kg)	Weight of Boom (kg)	Boom Length = **3.05 m** Maximum Experiment Weight (kg)	Weight of Boom (kg)
2 x 2 x .125	2.43	1.63	1.97	2.16	1.43	2.68		
2 x 2 x .188	3.42	2.41	2.73	3.19	1.92	3.97	1.10	4.75
2.5 x 2.5 x .188	6.39	3.04	5.08	4.03	3.74	5.01	2.48	6.00
3 x 3 x .188	10.45	3.67	8.25	4.86	6.18	6.05	4.36	7.24
3 x 3 x .25	13.27	4.83	10.40	6.40	7.70	7.96	5.34	9.53
3.5 x 3.5 x .25	19.98	5.67	15.55	7.51	11.66	9.35	8.40	11.19
4 x 4 x .25	28.21	6.51	21.79	8.62	16.45	10.73	12.13	12.85
4 x 4 x .375	39.34	9.61	30.08	12.73	22.45	15.84	16.31	18.96

* Center of Gravity of experiment must be kept within 12.7 cm of angle corner horizontallly and vertically

Table 2: Boom Length and Allowable Weight

6.5 General Requirements

6.5.1 Instruments shall have no radioactive sources.

6.5.2 Instruments and investigators will comply with the XD50 Safety Plan for General Laboratory Work at the NSSTC.

6.5.3 Instruments and investigators will comply with the NSBF Ground Safety Plan at all NSBF sites.

7.0 Field and Ground Operations

The DSTB ground development and integration facility is located at the National Space Science and Technology Center (NSSTC) in Huntsville, AL. The DSTB team at NSSTC will provide resources, equipment, and personnel for the assembly of each flight gondola and the integration and operational tests of approved flight payload systems. These efforts will be provided for each long duration expedition as well as any CONUS test flight that may be required. The facility and its resources will be available to support post-mission activity for the de-integration of payloads.

The NSSTC ground facility includes a visitor's office area as well as laboratory work space for use by visiting personnel during site visits for the integration and testing phases of planned flight expeditions. This space is located within laboratory room # 1118 of the NSSTC annex building. Access to the building and work areas is by magnetic ID badges which will be issued to visitors at initial check in. The visitor space provides a general use computer (unsecured internet access), telephones, workbenches, meeting tables, refrigerator and sink area, etc. The area serves as an on-site base of operations for DSTB visitors to Huntsville and includes handling equipment such as carts and lifts. Filing cabinets and some storage space for each experiment group can also be provided. Access to adjacent lab facilities of the local supporting Cosmic Ray research group is also available, on an individual request basis, for use of special need items such as bottled gases, liquid nitrogen, dry ice, or distilled water. These labs may also provide temporary use of some general laboratory equipment such as weigh scales, vacuum chamber, vacuum oven, oscilloscope, and some nuclear instrument modules for on-site use. A small contractor run machine shop is on site and may perform small jobs in an emergency. Use of radioactive materials for investigation experiments in any capacity will require coordination with and pre-approval by the NSSTC visitor coordinator. No radioactive materials are allowed into the NSSTC buildings without prior radiation safety officer approval.

A final pre-shipment gondola/payload weight and fit exercise will be performed at the Huntsville facility prior to shipment of the DSTB to Palestine, TX for the NASA/NSBF integration process, which is a procedure for all experiments bound for LDB flight operations. This ground check-out exercise will include a gondola hang test with full-up solar panel power operation for all instruments requiring power. Dummy loads will be used where it is not practical to utilize the actual flight equipment. Each investigator should plan to either deliver their DSTB provided instrument panel with the attached hardware in place for this exercise (including appropriate cables and connectors) ready for integration into the gondola system or allow sufficient preparation time to perform the attachment on-site at the Huntsville ground facility. Thermal coverings, if planned, can be affixed during final check-out either at Palestine, TX or Wiley Field, Antarctica. At the conclusion of the Huntsville exercise, which will involve an integrated gondola/payload shipping assessment, the gondola and instruments will be shipped to Palestine. Each investigator will be responsible for the shipping logistics of any ground support equipment required at Palestine. This same procedure will be followed for the DSTB Continental United States (CONUS) test flight, which is presently scheduled to occur in May of 2005.

The following is a listing of government furnished resources and equipment available at the Huntsville ground operations site.

1. 2000 ft^2 (185.81m^2) of high bay, laboratory and office space /w visitor PC and internet connections
2. Deep Space Test Bed gondola and general solar panel based power system
3. Mobile work tables
4. Medium and heavy duty lifting and moving equipment
    a. 500lb (226.80 kg) capacity (mobile) electric hoist
    b. 10 ton (9,071.85 kg) electric traveling crane (high bay)
    c. Fork lift

    d. 500 lb. (226.80 kg) capacity (mobile) laboratory hydraulic lift cart
    e. Engine hoist
5. Machine shop facility (small jobs)
6. DSTB Low level radiation sources (alpha, beta and neutron)
7. High wattage AC powered DC power supply (0-35V, 750 W)
8. Optical light pulser (100ps)
9. Distilled water
10. Weigh scales
11. Portable air conditioner
12. Bottled gases
13. Liquid Nitrogen
14. Small vacuum chamber access
15. Vacuum oven access
16. Ultrasonic cleaner access
17. Clean room access

Working visits to the Huntsville facility can be arranged thru the following contacts:

DSTB Visitor Coordinator:	Walter Fountain Tel. 256-961-7766 e-mail: walt.fountain@nasa.gov
DSTB Scientist:	Dr. Mark Christl Tel. 256-961-7739 e-mail: mark.christl@nasa.gov
DSTB Project Manager:	Martha Milton Tel. 256-961-7543 e-mail: martha.e.milton@nasa.gov
Engineering Contacts:	Jeff Apple - FCDS Tel. 256-961-7704 e-mail: jeff.apple@nasa.gov
	Tia Ferguson - Mechanical Subsystems Tel. 256-961-7712 e-mail: tia.ferguson@nasa.gov
	Ken Kittredge – Thermal Subsystem Tel. 256-544-3684 e-mail: ken.kettredge@nasa.gov
	Sue O'Brien - Power Subsystem Tel. 256-824-6133 e-mail: obriens @uah.

Appendix

i. DSTB Investigation Flight Application Form

DSTB Investigation Flight Application

Investigators Name: ____________________________________
Affiliation: ____
Address: ____
____
Phone: ____________Email: ____________________________

Brief Description of Investigation:
____
____
____
____
____
____
____

Estimated resource requirements:
Mass ____
Volume ____
Power ____
Telemetry ____
Commanding____
Thermal requirements __________________________________

Signature: ___________________________Date: _____________

Mail to: Dr. Mark Christl
320 Sparkman Dr.
Huntsville Al, 35806